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The OMNAR Flat Driver

A Breakthrough In Audio Technology

(Photo of OMNAR Driver showing sides and front)

The OMNAR Flat Driver is a significant development in audio technology that will have substantial impact on how speaker systems and other products are designed. It offers an outstanding combination of benefits which have been sought by audio engineers for many years. This new driver, now in the final stages of development, will be brought to market precisely at a time when other innovations in audio and video are pushing conventional drivers beyond the ultimate limits of their capabilities.

A brief review of some of these developments reveals why a radically different transducer concept like the OMNAR Flat Driver is so urgently needed now and in the years to come.

(Photo of Compact Disc player and Compact Discs)

1. WIDE DYNAMIC RANGE RECORDINGS AND ELECTRONICS. To an ever increasing degree music is being recorded with progressively greater and greater dynamic range. For today's direct-to-disc and digitally encoded recordings,

dynamic range exceeding 85 dB is commonplace. The result is that persons owning Compact Disc players or many other digitally encoded analog discs are finding that their speakers systems are either grossly distorting or self-destructing when they try to cope with the Herculean signals that have been captured by the latest recording technology. What's more this problem, no doubt, is going to worsen as such devastating dynamic range finds its way onto cartridges for Beta and VHS Stereo Hi-Fi VCRs. The conventional cone-type drivers used in TVs will not handle this kind of power.

(Photo of high-end audio components)

2. ULTRA-LOW-DISTORTION ELECTRONICS. As the years have passed, the harmonic, intermodulation and other measurable forms of distortion have gradually been reduced to vanishingly low levels. Today's preamplifiers have rated THD and IM distortions as low as 0.001%. And contemporary power amplifiers have distortion ratings as low as 0.002% at full output. Since most speakers systems introduce 5% or more distortion, they are responsible for as much as 80%-95% of the total distortion delivered by many high-end stereo component systems. The fact is that electromechanical transducers have not kept pace with electronics in the race to banish distortion and enhance fidelity.

(Photo of Stereo TV and/or projection TV)

3. STEREO, PROJECTION, AND FLAT SCREEN TVS. Anyone who keeps tabs on the consumer electronics marketplace can't help but be impressed by the flurry of developments being introduced for video enthusiasts. Stereo television receivers and stereo VCRs are finally bringing to the TV medium the same sonic excitement that audio enthusiasts have been enjoying for some time. And not only is the signal encoded in stereo, but, by virtue of the latest digital technology, it will ultimately feature low distortion and vastly expanded dynamic range. In order for flat screen TV to become a reality, speaker technology is going to have to make substantial progress...virtually overnight! All such factors are combining to create a growing need in the television industry for compact, narrow, shallow draft, low distortion, audio drivers with high efficiency and markedly higher power handling capabilities.

(Photo of high-end car stereo components)

4. HIGH-END CAR STEREO ELECTRONICS. The advent of high quality car stereo head amps, power amps, equalizers, electronic crossovers, wide-range speakers systems, and other such components have brought to the automobile the kind of sophisticated audio reproduction which, until recent years, was available only in the home. However, due to space limitations and other restraints inherent in the automotive environment, driver designers and manufacturers have found it challenging to keep up with the escalating performance capabilities of car stereo equipment. The result has been a great many blown drivers and frustrated customers. And now that Compact Disc players, with their awesome dynamic range, have become available for automobiles, the situation can only worsen.

Myriad audio equipment manufacturers, particularly the automotive OEMs, are being required by the demands of the marketplace to implement two diametrically opposite goals simultaneously. They are being asked to reduce driver depth significantly (which means reducing cone depth) and, at the same time, increase driver performance, including power handling. The crux of the problem is that the standard structural element of conventional drivers--the cone--is most rigid in a deep draw configuration. As a cone is flattened or reduced in depth, it loses strength exponentially and, therefore, sounds worse, not better. It also handles less power. Since such conflicting market demands cannot possibly be satisfied by cone driver technology, this situation poses a serious problem for present and future product applications. There exists a critical need in this industry for a compact, shallow draft, low impedance, low inductance, economical driver that combines high power handling with smooth response, low distortion, and high efficiency.

Having explored some recent audio developments and desirable transducer characteristics, let us examine the OMNAR Flat Driver to see how it works and how it compares with other kinds of drivers in terms of benefits to the end user.

HOW IT WORKS

(Cutaway drawing or photo of OMNAR Driver)

The OMNAR Driver is markedly different from conventional cone drivers and their cousins, the Japanese planar drivers (Sony and others), in how the motor force is generated and distributed to the sound radiating surface. The driving element or structure of this unusual electro-acoustic transducer is formed from a sheet of thin film material which bears a pattern of conductive tracks. When the diaphragm is formed these conductive tracks constitute a set of linear voice coils on an array of projecting fins or vanes. A flat, rectangular, thin, extremely rigid aluminum honeycomb membrane is attached to the top of this thin film structure to serve as the sound producing diaphragm. The resulting membrane assembly is extremely lightweight and rigid. The magnet assembly is designed so that the voice coil projections are suspended in a series of corresponding linear magnetic gaps.

(Photo of OMNAR Driver diaphragm/voice coil assembly alone)

Due to its unique linear design, the OMNAR Driver is able to take advantage of the principle of DISTRIBUTED DRIVE. Unlike a conventional cone driver, which must disperse the force generated by the voice coil up the cone, the OMNAR Driver generates the force over a much wider area relative to the total driving surface of the diaphragm.

HOW IT COMPARES

In an 8-inch conventional driver with a large 2-inch voice coil, the 6.75-inch cone has an area of approximately 38 square inches and this area is driven essentially by the 6-inch circumference of the voice coil. This means that about 6.33 square inches of radiating area is driven by each linear inch of driving element. In the case of the OMNAR Driver, a radiating surface of 16 square inches is driven by 30 inches of linear driving element. Therefore, only about 1/2 square inch of radiating surface is driven by each linear inch of driving element. The result, in this instance, is that the OMNAR Driver distributes its drive 12.66 times more effectively than does a conventional cone driver! In comparisons between larger cone drivers and larger OMNAR

Drivers, the differences are even more dramatic. In addition, because it is modular in concept, the OMNAR membrane maintains the same density of support structures no matter how large the membrane is made for different size drivers. Thus, the structural integrity of the membrane remains constant, even as its size increases. However, such is not at all the case with conventional drivers. Larger cones have a much larger ratio of radiating surface to drive element than do smaller ones.

But that's not all. The diaphragm also has about two-thirds the mass of an 8-inch driver cone. So it is much easier to put into motion and to reverse direction. Low mass is one of the factors which gives the OMNAR Driver its excellent efficiency, relative to other flat driver concepts (to be discussed later). The combination of DIRECT DISTRIBUTED DRIVE and low mass creates a driver which approaches the textbook ideal of an acoustic piston.

(Illustration showing out-of-phase signals emanating from the cavity of a cone-type driver versus in-phase signals emanating from the flat membrane of an OMNAR Driver.)

Inherent within conventional cone drivers is a phenomenon referred to as "Cavity Effect" distortion. Sound waves emanating from the inner part of a cone have farther to travel to the ear than do those generated by the same electrical impulse but which emanate from the outer edge of the cone. Since they travel different distances, they reach the ear at different times, creating undesirable phase cancellations as well as the smearing of subtle musical details. The total absence of this effect is a key factor responsible for the superb clarity exhibited by the OMNAR Driver (and by electrostatic headphones as well).

(Drawing or photo of dome-type driver)

Likewise, dome drivers are not without problems and shortcomings. Some of these shortcomings include their mechanical and electrical fragility, and their general vulnerability to vandalism or mischief. In terms of mass per driven area, the OMNAR Driver membrane compares

favorably with the best dome tweeters and features a flat, durable surface which is far more resistant to both physical and electrical abuse. The use of dome drivers also necessarily involves crossover and mounting problems which result in complicated interference patterns and irregular frequency response throughout most listening positions.

While there are a number of speaker systems currently on the market which feature planar-type drivers, none provide high fidelity sound reproduction at a low manufactured cost. Unlike the OMNAR Driver, they do not lend themselves to high volume mass production techniques vital to cost minimization. Unfortunately, for them, they also share a variety of other deficiencies.

(Drawing or photo of Magnepan speaker systems)

Magnepan speaker systems offer respectable sound reproduction, but they are expensive, large, and extremely inefficient. Being bipolar radiators, they must be placed at least 5 feet away from any walls, and they are notably deficient in bass response. Because they utilize a tensioned, flexible mylar sheet as the diaphragm, this sheet can develop nodes and instabilities and does not behave as a rigid piston.

(Photo or drawing of QUAD electrostatic speaker systems)

Electrostatic speaker systems have placement problems similar to those of the Magnepans. And although they don't necessarily need 200-watt-per-channel amplifiers that the Magnepans require, they do need amplifiers that are very tolerant of high capacitive loads, and such amplifiers also are expensive. Electrostatic speaker systems tend to collect dust and must be specially cleaned periodically. Also, since they have separate panels to radiate the high and low frequencies, they cannot offer the advantage of smooth, evenly dispersed frequency response, which is inherent in the full-range OMNAR Driver.

Sony, Technics, Onkyo, and Hitachi have all made a commitment to the flat driver concept. Because the round voice coil/bobbin/magnet is the most convenient mode of motor assembly, all of these companies have chosen to use the round voice coil as their driving mechanism. So their

driver designs are based on mounting a flat surface to the voice coil. To work properly, this surface must remain rigid. To keep it rigid, the Japanese manufacturers have incorporated multiple structural supports which serve to couple the voice coil to the planar surface and to transmit and disperse the force produced by the voice coil. Instead of finding a way to drive the flat membrane evenly, as is the case with OMNAR's DIRECT DISTRIBUTED DRIVE technology, they have concentrated their efforts on trying to keep the membrane flat when driven unevenly. That this approach has not worked is evidenced by flat driver systems which sound mediocre, are selling slowly, and are expensive.

(Photo or drawing of Technics' flat driver and/or flat driver speaker systems)

Sony comes closest to DISTRIBUTED DRIVE because they use four voice coils to drive each large woofer membrane. However, while the result is a distinguished high-end speaker system, it costs thousands of dollars per pair. Consequently, this approach is much too expensive to become practical or popular. In addition, Sony's approach does not provide the important advantages of a full-range driver.

A careful review of cone, dome and planar driver designs has lead us to the conclusion that the action of the diaphragm of the OMNAR Driver much more closely approaches the theoretical ideal of a true flat piston than that of any other driver. Only DIRECT DISTRIBUTED DRIVE together with the meticulous selection of high performance, low-mass materials and a geometrically rigid design of the driver membrane makes this achievement possible. (See Patent No. 4,491,698)

BENEFITS AND ADVANTAGES

The OMNAR Driver with its principle of DIRECT DISTRIBUTED DRIVE and its associated manufacturing technology offers a host of benefits and advantages. These dividends extend to audio engineers, audio and video equipment manufacturers, retail stores, and certainly to the ultimate consumer.

1. HIGH ACCURACY AND LOW DISTORTION. Refined OMNAR Driver designs should provide demonstrably better performance as compared to conventional drivers. Being a full-range

transducer, the OMNAR Driver offers substantial sonic advantages over arrangements involving the use of multiple narrow-range drivers. Aside from having crossovers and associated problems (see below), most speaker systems incorporating multiple narrow-range conventional drivers suffer from inherently irregular off-axis frequency response due to constructive and destructive interference effects. Such drivers cannot be placed close enough together to eliminate these effects. With respect to distortion, the open back of the OMNAR Driver permits easy treatment of the back wave and optimum loading to control excursion and minimize low frequency distortion. (This is not possible with most types of planar drivers.) Likewise, high frequency distortion measurements made on crude prototypes of this driver yielded results that were below the residual distortion of the test equipment of a major speaker system manufacturer. The audible difference is immediately discernable, even to the uneducated ear.

(Graph of the OMNAR Driver's frequency response or distortion. Curve must be extremely good to be adequately impressive.)

2. HIGH EFFICIENCY, POWER HANDLING AND DYNAMIC RANGE CAPABILITY. Because the voice coil of the OMNAR Driver is in the magnetic gap, the electrical to mechanical energy conversion is quite efficient. This is in sharp contrast to virtually all other types of planar drivers which do not use gap-driven voice coils and suffer very low efficiency as a result. Power handling of machine-formed membranes should be unusually high due to their DISTRIBUTED DRIVE structural design, and high heat-resistant materials. Furthermore, the driver is designed to provide convection cooling (see below). Since dynamic range capability is a function of both efficiency and power handling capacity, both of which are high, the OMNAR Driver should easily provide the dynamic range which today's Compact Discs and other digitally encoded program sources demand. In fact, due to its unique DIRECT DISTRIBUTED DRIVE design, the OMNAR Driver should be able to achieve a mimimum of 10 times the power handling or dynamic range capabilities of the best conventional drivers made today.

(Photo of back side of OMNAR Driver showing ventilated magnet structure)

3. LOW HEAT OPERATION. The OMNAR Driver resists heat build up and driver failure due to overheating because the harder the driver is made to work, the more effectively it cools its conductive tracks to insure consistent performance and longevity. It has no restricted chamber, but rather is open front and rear to permit air circulation and convection cooling. Other factors which contribute to the cool running operation of the OMNAR Driver are a well-ventilated magnet structure which allows more air circulation; wide, thin flat conductors, which offer much more surface area for heat dissipation than do the tightly stacked and multiple-layered wires within a conventional voice coil; and wider spacing between adjacent conductors. The high temperature structural film materials melt at 750 degrees Fahrenheit and, therefore, will withstand the most severe environmental temperature extremes.

(Photo or drawing of crossover components)

4. ELIMINATION OF CROSSOVER AND ASSOCIATED PROBLEMS. Crossovers have always posed severe problems for speaker system designers. Not only are crossovers expensive, but they contribute to impedance/frequency response irregularities. Crossovers often cause impedance dips which are extremely low and potentially damaging to amplifiers. This is particularly true if level controls are incorporated into speaker systems in order to compensate for differing driver efficiency. Likewise, crossovers generally increase distortion. In particular, the low impedances that can occur in 12 dB per octave crossovers can greatly boost amplifier intermodulation distortion. However, since the OMNAR Driver can be used as a full-range driver, no crossover is necessary and all these associated problems can be eliminated. Even in space-restrictive environments where use of two-way systems is desirable--such as in automotive applications--greatly simplified first order crossovers could be deployed which would limit their expense and minimize their negative effects on the systems' function.

(Graph of the OMNAR Driver's impedance curve. If not flawless, should be omitted.)

5. LOW, SMOOTH IMPEDANCE WITH RELATIVELY LOW INDUCTANCE. The OMNAR Driver can be designed in most any impedance

configuration desired, making it ideal for design applications. If offers the advantage of very low inductance. In fact, it is almost purely.resistive in nature, and its impedance curve is reasonably flat and smooth throughout the entire audio frequency range. Because of these characteristics, it can be put in series or parallel to the engineer's preference, and it allows series/parallel combinations that would be impossible with conventional drivers. Low impedance, low inductance systems, which are very desirable in certain design applications (such as in automobile stereo systems where power is at a premium), are a simple matter to design.

6. OUTSTANDING TRANSIENT RESPONSE. Because of the very short distance between the driving element (voice coil) and every part of the sound radiating surface, the machine-formed membrane should be driven essentially instantaneously to frequencies beyond 40 kHz. Since, in this instance, there is virtually no propagation delay, the OMNAR Driver should exhibit an extraordinarily fast rise time and extremely good transient response. In this regard, the design of the OMNAR Driver is inherently superior to that of any cone driver and is matched only by electrostatic drivers, which suffer from other serious problems.

(Photo or drawing of the front and side views of the OMNAR Driver)

7. SHALLOW DRAFT AND LONG, NARROW SILHOUETTE. The production version of the OMNAR Driver will measure about 1.5 inches deep, 14 inches long, and 4.25 inches wide, and much smaller drivers (about 1 x 5 x 3.5) are possible. Therefore, it can easily be applied to automotive applications, especially those involving shallower bodies such as compacts and sports cars. With their long, narrow silhouette, OMNAR Drivers are a natural for use in Stereo TVs and may prove even more popular for flat screen TVs. Custom versions of the driver can be produced with depths of 0.5 inch or less, and with different length-to-width ratios in order to accommodate specialized applications.

(Photos or drawings of sports cars, airplanes, boats, etc.)

8. ENORMOUS DIVERSITY OF POTENTIAL APPLICATIONS. As the wide ranging advantages of the OMNAR Driver become well known to product designers, there may be few applications for which they will not be considered and deemed preferable. For instance, membrane sizes could range from miniaturized cells 0.5 inch deep or less, to huge 30-inch square woofers capable of 1.5-inch excursions and generating awesome loudness levels. Because the diaphragm/voice coil assembly is impervious to moisture, they can be used outdoors and will be welcomed on boats and planes. Possibilities for portable applications abound. Very few transducers since the development of the original conventional cone driver have held so much promise.

9. MAXIMUM FLEXIBILITY FOR DESIGNERS AND ENGINEERS. Because of its compactness, ideal impedance characteristics, economy, and other factors, designers are freer to innovate and decide how best to capitalize on its many advantages. Use of the OMNAR Driver may well permit high fidelity reproduction to be brought to places it has never been before. Strikingly new speaker system shapes and styles are a virtually a certainty. For engineers and designers alike, the OMNAR Driver overcomes a multitude of aggravations and limitations.

(Photo of OMNAR Speaker System)

10. UNIQUE MARKETING LOOK. When marketing people think of selling consumers on something entirely new they know that their products must LOOK new to demand the attention of buyers. The long, narrow, flat radiating surface of the OMNAR Driver has a unique, high-tech appearance that cannot be mistaken for anything else in the marketplace. One glance tells the buyer that this is no common speaker--that this is different. In addition, its perfectly flat membrane will prompt recall of the many advertisements by credible audio firms (such as Sony and Technics), promoting the flat driver as the ultimate audio speaker system.

(Drawings or photos of cutaway side views of speaker system containing conventional drivers and one having OMNAR Drivers)

11. COMPETITIVE PRICING. Attractive system pricing makes this driver extremely competitive with other high quality

audio drivers which cannot offer a fraction of its advantages and benefits. The fact that this driver can sound better while replacing multiple drivers of different sizes, crossover components and wiring (with economic and space savings in the bargain), suggests it should meet with widespread acceptance.

12. OUTSTANDING MANUFACTURABILITY. Since the design of the OMNAR Driver represents such a substantial departure from current conventional driver design, OMNAR TECHNOLOGIES is developing an entirely new manufacturing process that will assure production quantities sufficient to meet market demands. At present, driver manufacturing involves considerable numbers of components and a great deal of hand labor in assembly. Because of the nature of the materials used in the OMNAR Driver and the design of the driver, most of the manufacturing process can be automated using equipment designed by OMNAR TECHNOLOGIES, INC. This equipment, which is proprietary, involves the thermo-forming of plastic sheets upon which a conductive circuit has been printed. The machine tooling likewise is capable of producing a variety of cell sizes and configurations.

(Photo or drawing of a pensive designer or engineer holding the OMNAR Driver and happily pondering how he is going to make use of it.)

The OMNAR Driver is a development whose time has come. Each passing day brings forth new demands which cannot be resolved within the limitations of current technology. Experience and common sense are compelling audio engineers to turn to flat driver technology for future driver applications.

The OMNAR Technology offers a logical, viable alternative which, if brought to fruition in a timely manner, has the potential to establish itself as the new standard for acoustic drivers. At the same time, it should also make extended-range high fidelity reproduction available and affordable to a much wider audience than previously has been possible.